The Flavor Tagger

- The flavor tagger is responsible for the determination of the flavor $q$ of $B^0$. It considers decays with flavor specific signatures (charges of final state tracks) and sizable branching fractions ($B > 2\%$).
- The information related to the kinematics and the particle identification of the tracks and the clusters which remain from the reconstruction of $B^0 \to J/\psi K^0$ is combined using boosted decision trees (BDT). The method returns the flavor $q = \pm 1$ for $B^0(B^\pm)$ multiplied by a dilution factor $r \in [0,1]$

Time Dependent CP-violation Analysis of $B^0 \to \pi^+\pi^-$

- The CP asymmetries of $B^0 \to \pi^+\pi^-$ are required to determine the CKM angle $\phi_2$.
- At present, there is not enough data to perform the time-dependent analysis.
- Belle II will have enough data to exploit rare events with converted photons $\gamma \to e^+e^-$ and with pions data $e^+e^-\gamma$ decays.

Variables for Maximum Likelihood Fit

- $m_{e\tau} = \sqrt{m_{e\tau}^2 + M_{B^\pm}^2}$

Determination of $\phi_2$ via Isospin Analysis

- The CKM angle $\phi_2$ is related to the CP asymmetries of the decays $B^+ \to \pi^+\pi^-$ and $B \to \pi\tau$. However, because of non-negligible penguin contributions, the value of $\phi_2$ cannot be extracted directly. The way out: isospin symmetry gives rise to two relations between the decay amplitudes from which one can extract the value of $\phi_2$.
- The isospin analysis requires the branching fractions $B_{s,0}$. $B_{s,0}$ together with the CP asymmetries $A_{cp}$, $S_{cp}$ and $S_{b,0}$ (the subscripts denote the pion or rho charges). Without $S_{b,0}$, the $\phi_2$ value has an 8-fold ambiguity in the case of $B^+ \to \pi^+\pi^-$ and is less precise in the case of $B \to \pi\tau$. 

CP Violation sensitivity at Belle II

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